

ENUM -- Telephone Number Mapping
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**Combined User and Infrastructure ENUM in the e164.arpa tree
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Abstract

This memo defines an interim solution for Infrastructure ENUM to allow a combined User and Infrastructure ENUM implementation in e164.arpa as a national choice until the long-term solution is approved. This interim solution will be deprecated after deployment of the long-term solution.

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1. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#), [RFC2119](#) [1].

Note: The ENUM WG decided at IETF#64 to prefer the term Infrastructure ENUM. Therefore, this document uses the term Infrastructure ENUM as synonymous to Carrier ENUM.

2. Introduction

ENUM (E.164 Number Mapping, [RFC 3761](#) [2]) is a system that transforms E.164 numbers [3] into domain names and then uses DNS (Domain Name Service) [6] services like delegation through NS records and NAPTR (Naming Authority Pointer) records [4] to look up which services are available for a specific domain name.

ENUM as defined in [RFC3761](#) (User-ENUM) is not well suited for the purpose of interconnection by carriers, as can be seen by the use of various private tree arrangements based on ENUM mechanisms.

Infrastructure ENUM is defined as the use of the technology in [RFC3761](#) [2] by the carrier-of-record [8] (Voice service provider) for a specific E.164 [3] number to map a telephone number into an URI [5] that identifies a specific point of interconnection to that service provider's network that could enable the originating party to establish communication with the associated terminating party. It is separate from any URIs that the end-user who registers his E.164 number in ENUM may wish to associate with that E.164 number.

The requirements, terms and definitions for Infrastructure ENUM are defined in [8].

Using the same E.164 number to domain mapping technique for other applications under a different, internationally agreed apex (instead of e164.arpa) is straightforward on the technical side. Establishing the international agreements necessary to delegate the country-code level subdomains under the new apex is non-trivial and time-consuming. This process of defining the Dynamic Delegation Discovery System DDDS [4] application for Infrastructure ENUM in "ie164.arpa" is under way [9]. This is called the "proper" long term solution.

3. Interim Solution

As stated above, the agreements to establish the long-term solution

may take some time. It was therefore decided to develop an interim solution that can be used by individual countries to implement an interoperable Infrastructure ENUM tree immediately. The Interim solution will be deprecated upon approval (loosely timed) of the "proper" long-term solution.

It is therefore also required that the Interim solution is compatible with the "right" long-term solution to allow for easy migration.

4. Introducing a branch into the 164.arpa tree

A convention is needed how, given a fully qualified E.164 [3] number, a resolver can determine the location of the Infrastructure ENUM subdomain for this country. Under this approach, ITU-T and IETF (IAB) involvement is only lightweight, e.g. to recommend the proper algorithm defined here to enable international interoperability.

This allows to introduce the Interim solution as a national matter by the concerned NRA or as a regional opt-in within in a given Numbering Plan Area such as the North American NPA.

Beyond the setup phase, an NRA need not be involved operationally - it is sufficient to establish a convention linking the national definition of a carrier of record to the credentials for write access to the Infrastructure ENUM tree.

The method most easily fulfilling the above mentioned requirements is to branch off the e164.arpa tree into a subdomain at or somewhere below the country code delegation level below e164.arpa, and deploy an Infrastructure ENUM subtree underneath without touching User ENUM semantics at all.

5. Defining the Infrastructure ENUM branch location

The decision where to place the Infrastructure ENUM tree below e164.arpa is a national or group-of-countries decision. To branch off the e164.arpa tree for a given country code, a DNS label is inserted at a specific position into the ENUM fully qualified domain name (FQDN).

For international interoperability, an Infrastructure ENUM resolver needs to determine for a given country code

1. the name of the label to be inserted

2. the position where to insert the label in an Infrastructure ENUM domain name for a given country code
3. a convention how to discover these parameters.

We propose a mechanism to discover these parameters dynamically for any given tree shape as follows:

- o the national or group-of-countries decision about subdomain location is documented in the e164.arpa tree proper by inserting a special DNS resource record at the country code level, called ENUM Branch Location Record (EBL) [7], into a subdomain in the country code zone. In case of the Infrastructure ENUM application, this subdomain name will be "infrastructure". This ENUM Branch Location Record carries three values for maximum flexibility:
 - o 1. the branching label to be inserted into the ENUM domain to branch off to the application-specific tree. This may be an empty (zero-length) string.
 - o 2. an insertion position, indicating after which digit this label should be inserted into the ENUM domain to branch off to the application-specific tree. A value of 0 means "after all digits".
 - o 3. an apex: indicating what domain should replace "e164.arpa" for this application.
- o a resolver looking for an Infrastructure ENUM domain needs to retrieve this EBL once during first resolution within a country code.
- o while constructing the FQDN, the branching label as retrieved from the EBL resource record is inserted at the insertion position (also as per EBL) and finally the apex is appended. Labels, digits and apex are separated by dots as usual. A zero-length branching label is not inserted at all.

6. Finding the ENUM branch location record

The only remaining a-priori knowledge a Infrastructure ENUM resolver should have is the current list of country codes, or an equivalent method to determine where the country code in the number ends.

To prime the country code extraction algorithm, the current scheme to determine country code length as follows could be employed:

- o 3 digits is the default length of a country code.
- o country codes 1 and 7 are a single digit.

- o the following country codes are two digits: 20, 27, 30-34, 36, 39, 40, 41, 43-49, 51-58, 60-66, 81, 82, 84, 86, 90-95, 98.

Figure 1

Given the fact that the ITU recently allocated only 3-digit country codes, there are no more spare 1- and 2-digit country codes and existing 1- and 2-digit country codes are extremely unlikely to be recovered, the above table consisting of the existing 1- and 2-digit country codes can be considered very stable. The only problem may be a country split as happened recently e.g. to Yugoslavia.

If a branch location record is not found according to this table (for instance, in the unlikely case the ITU allocates a country code not according to these rules), it is still possible to determine the branch location record by "iterating down" the tree digit-by-digit. Such a fallback strategy would rely on the assumption that there is never a branch location record inserted above the country code zone, for which there would be no use in the first place.

It seems unlikely that inspection of more than the first five digits will be required to locate the branch location record under any realistic numbering administrative partitioning.

7. Recommended resolver behaviour

A User ENUM resolver as per [RFC 3761](#) need not be aware of any Infrastructure ENUM conventions at all. A combined User and Infrastructure ENUM resolver shall behave as follows:

The input to the resolver routine shall be:

1. the called number in fully qualified E.164 (international) format,
2. a mode parameter indicating whether resolution should follow User ENUM or Infrastructure ENUM rules (for instance, a null value for defaulting to User ENUM, or 'infrastructure' for Infrastructure ENUM semantics).
3. optionally a table or algorithm to easily detect country codes ([Section 6](#)),
4. any other parameters used to drive the search, for instance an enumservice type. These parameters are outside the scope of this draft.

The resolver shall proceed as follows:

- o if the mode parameter indicates a User ENUM search, proceed as per [RFC3761](#).

- o If the mode parameter indicates an Infrastructure ENUM query:
 - * determine country code length.
 - * consult table if an EBL record for this country code was already retrieved since resolver boot time.
 - * if not:
 - retrieve the EBL record from the 'infrastructure' subdomain of the country code zone, and store the country code and associated EBL values in an EBL table.
 - optional fallback for irregular country code not covered by the CC extraction algorithm: (Figure 1) if the last step fails, iterate over the number up to five digits and try to retrieve the EBL record in the 'infrastructure' subdomain each time, again storing the country code and associated EBL values in the cache if successful.
 - if both attempts fail, return NXDOMAIN.
 - * valid EBL record found: if the branching label is non-zero length, insert it at the insertion position in the FQDN and add a trailing dot, add the remaining digits and dots, and append the apex.
 - * search the DNS for any ENUM NAPTR records for the resulting domain name.

It is assumed that already discovered EBL values are stored in a cache table of country code and already discovered EBL parameters.

8. Security considerations

Privacy issues have been raised regarding unwarranted disclosure of user information by publishing Infrastructure ENUM information in the public DNS, for instance the use for harvesting of numbers in service, or unlisted numbers.

Given that number range allocation is public information, we believe the easiest way to cope with such concerns is to fully unroll allocated number ranges in the Infrastructure ENUM subtree, wherever such privacy concerns exist. Whether a number is served or not would be exposed by the carrier of record when an attempt is made to contact the corresponding URI. We assume this to be an authenticated operation, which would not leak information to unauthorized parties.

Entering all numbers in an allocated number range, whether serviced or not, or listed or unlisted, will prevent mining attempts for such number attributes.

The result would be that the information in the public DNS would mirror number range allocation information, but not more. Infrastructure ENUM will not tell you more than you can get by just

dialing numbers.

The URI pointing to the destination network of the Carrier of Record should also not disclose any privacy information about the identity of end-user, it is therefore recommended to use in the user-part of the SIP URI either anonymized UserIDs or the E.164 number itself, such as sip:441632960084@example.com .

The definition of a new resource record (RR) type or a new enumservice does not introduce security problems into the DNS. Usage of the Branch Location record conveys only static setup information under a country code subtree of e164.arpa. The intended use of DNS Security Extensions (DNSSEC) within ENUM will prove authenticity of the conveyed value.

9. IANA considerations

None

10. Interoperability considerations

An application using the combined resolver needs to indicate which information is requested - User or Infrastructure ENUM, or both. A user-ENUM-only resolver need not be aware of the Infrastructure ENUM subtree and no changes with respect to [RFC3761](#) semantics are required. A resolver desiring to retrieve Infrastructure ENUM or both types of records needs to be aware of the conventions laid out in this draft.

When the "proper" long-term solution is adopted, each country using the interim solution may decide on its own when to migrate to the long-term solution. The EBL records for this country would then be changed to the values "insertion position=0", "branching label='" and "apex=ie164.arpa". When finally all countries have migrated, the EBL records may be removed.

11. Acknowledgements

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12. References

12.1. Normative References

- [1] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [2] Faltstrom, P. and M. Mealling, "The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery System (DDDS) Application (ENUM)", [RFC 3761](#), April 2004.
- [3] ITU-T, "The International Public Telecommunication Number Plan", Recommendation E.164, May 1997.
- [4] Mealling, M., "Dynamic Delegation Discovery System (DDDS) Part One: The Comprehensive DDDS", [RFC 3401](#), October 2002.
- [5] Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifiers (URI): Generic Syntax", [RFC 2396](#), August 1998.
- [6] Mockapetris, P., "Domain names - concepts and facilities", STD 13, [RFC 1034](#), November 1987.
- [7] Lendl, O., "The ENUM Branch Location Record", [draft-lendl-enum-branch-location-record-01](#) (work in progress), May 2006.

12.2. Informative References

- [8] Lind, S. and P. Pfautz, "Infrastructure ENUM Requirements", [draft-ietf-enum-infrastructure-enum-reqs-02](#) (work in progress), April 2006.
- [9] Livingood, J., "The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery System (DDDS) Application for Infrastructure ENUM", [draft-ietf-enum-infrastructure-00](#) (work in progress), April 2006.

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